Protocol

Investigating 24-Hour Movement Behaviors in Young People With Learning Disabilities: Protocol for a Mixed Methods Study

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Abstract

Background: Physical activity (PA), sedentary behavior (SB), and sleep play a key role in the health and development of young people. This has led to the development of guidelines on PA, SB, and sleep for children and young people aged 5 to 17 years. Adherence to these integrated guidelines is associated with favorable physical, mental, and cognitive health outcomes. However, evidence regarding 24-hour movement behaviors (MBs) among young people with learning disabilities is scarce, particularly in the United Kingdom, where no studies have comprehensively examined adherence to all guideline components or explored the factors influencing these behaviors in this population.

Objective: This study aims to investigate 24-hour MBs among young people with learning disabilities in Scotland, United Kingdom; determine adherence to PA, SB, screen time, and sleep recommendations; assess the feasibility and acceptability of measuring 24-hour MBs in this population; and explore individual, social, and environmental barriers to and facilitators of MBs.

Methods: This mixed methods study recruited young people aged 11 to 17 years who attended secondary schools for children with additional support needs (ASN) in Scotland. Participants were asked to wear an ActiGraph GT3X accelerometer continuously for 7 consecutive days to objectively assess PA, SB, and sleep. Parent- and youth-completed diaries captured sleep schedules, screen time, and monitored nonwear periods. Individualized activity profiles were produced to summarize participants' daily MBs and support engagement in the qualitative phase. A purposive subsample participated in semistructured interviews exploring experiences, barriers, and facilitators associated with MBs. Quantitative data will be analyzed descriptively to determine MB patterns and guideline adherence, while qualitative data will undergo thematic analysis informed by the capability, opportunity, and motivation–behavior (COM-B) model, the theoretical domains framework and the behavior change wheel.

Results: The study was funded by the Baily Thomas Charitable Fund from April 2025 to July 2026. Ethics approval was granted by the University of Strathclyde Ethics Committee (UEC25/10). Recruitment and data collection were completed in June 2026 across participating ASN schools in Scotland. This manuscript describes the study protocol and planned analyses; however, data cleaning and analysis were ongoing at the time of submission. Quantitative and qualitative findings are expected to be disseminated through peer-reviewed publications and conference presentations during 2027.

Conclusions: This study is among the first in the United Kingdom to comprehensively examine all components of the 24-hour MB framework in young people with learning disabilities using objective measurement and qualitative inquiry. The findings will provide important evidence on MB patterns, guideline adherence, and modifiable determinants of behavior, informing the development of theory-informed, inclusive interventions designed to improve health and well-being among young people with learning disabilities.

International Registered Report Identifier (IRRID): DERR1-10.2196/94581

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(JMIR Res Protoc 2026;15:e94581) doi: 10.2196/94581

KEYWORDS

24-hour movement behaviors; learning disabilities; physical activity; sedentary behavior; screen time; sleep; adolescents; mixed methods

Introduction

Background

Physical activity (PA), sedentary behavior (SB), and sleep play a key role in the health and development of children and young people [1,2]. This has led to the development of guidelines on PA, SB, and sleep for children and young people aged 5 to 17 years [3,4]. Young people aged 12 to 17 years should engage in an average of at least 60 minutes of moderate-to-vigorous PA per day, primarily involving aerobic activities and several hours of varied light-intensity movement activities. Although the World Health Organization (WHO) guidelines recommend limiting sitting time (specifically recreational screen time), evidence-based guidelines in some countries—for example, Canada, Australia, and New Zealand—specify limiting recreational screen time to no more than 2 hours per day and breaking up long periods of sitting as often as possible [1,2,4]. Young people are also recommended to achieve 9 to 11 hours of uninterrupted sleep per night (at ages 12 to 13 years) or 8 to 10 hours of uninterrupted sleep (at ages 14 to 17 years), while maintaining consistent bed and wake times [5].

A growing body of evidence shows that PA, SB, and sleep interact with one another within a 24-hour period [2]. Therefore, it is important to acknowledge that each of the 3 movement behavior (MB) components (ie, PA, SB, and sleep) has the potential to influence the others. For example, poor sleep, if unaddressed, may reduce the likelihood of engaging in PA and may contribute to increased levels of SB [4]. Several studies have indicated that young people who meet at least 2 of the 3 24-hour MB guidelines have better cognitive function, improved mental health, and lower mortality in adulthood compared with those who meet none of the guidelines [6-8].

Similar findings have been reported in studies involving children and young people with a range of conditions, including autism spectrum disorder (ASD), attention-deficit/hyperactivity disorder (ADHD), and intellectual and developmental disabilities, with these studies demonstrating low adherence to the 24-hour MB guidelines. For example, a recent study found that individuals with intellectual disabilities spent substantial amounts of time engaged in SB and were less likely to achieve recommended levels of PA [9]. These findings highlight the challenges that many young people with disabilities face in meeting the integrated recommendations for PA, SB, and sleep. In a 7-country observational study, only 2% of children and young people with ASD adhered to all 3 24-hour MB guidelines, while 22% did not meet any of them [10]. Consistent with these findings, a recent systematic review and meta-analysis reported that, compared with individuals with disabilities who met at least 2 of the 3 24-hour MB guidelines, those who failed to meet any guideline experienced higher levels of anxiety, depression, and other mental health symptoms [7]. Furthermore, studies have demonstrated that individuals with ASD who adhere to all 3 24-hour MB guidelines report significantly higher quality of life than those who do not meet any of the recommendations [10,11].

Comparisons across studies are complicated by inconsistent terminology, including intellectual disabilities, learning disabilities, neurodevelopmental disorders, physical disabilities, cognitive impairments, and specific learning disorders. These heterogeneous populations have distinct characteristics and support needs, limiting comparability and generalizability across studies and making it challenging to define study populations consistently [12]. For the purposes of this study, young people with learning disabilities are defined as individuals who meet the following three criteria: (1) global intellectual impairment (IQ<70), (2) significant support needs in everyday activities, and (3) onset before 18 years of age. Learning disabilities may have a recognized cause (eg, Down syndrome and Williams syndrome), but the cause is often unknown. Young people with learning disabilities often have co-occurring physical and mental health conditions, disabilities, and/or impairments [13].

Although the health-related benefits associated with meeting all 3 24-hour MB guidelines are well established [14], considerably less is known about adherence and associated outcomes among children and young people with learning disabilities. For example, Huang et al [7] reported that only 1 study included participants with learning disabilities in their systematic review. Existing research has predominantly focused on broader disability populations or specific conditions such as ASD [15], ADHD [16], and cerebral palsy [17]. However, these conditions do not necessarily share the same characteristics, support needs, or patterns of comorbidity as learning disabilities. Consequently, the experiences and health outcomes of young people with learning disabilities remain underrepresented in research on 24-hour MBs. This evidence gap limits understanding of their unique MB profiles and may hinder the development of targeted interventions and evidence-based recommendations for this population.

With regard to promoting adherence to the 24-hour MB guidelines, evidence suggests that interventions should focus on increasing PA, reducing SB, and improving sleep among children and young people with learning disabilities [18,19]. However, achieving these recommendations may be particularly challenging for this population. Young people with disabilities often encounter a range of barriers to PA participation, including interpersonal, social, and environmental factors that can limit opportunities for engagement [17,20]. Furthermore, sleep disorders are highly prevalent among adolescents with learning disabilities and may exacerbate behavioral difficulties, negatively affect well-being, and complicate the provision of care and support [5,21]. Additional challenges may arise from the diverse nature of learning disabilities and co-occurring conditions. Difficulties associated with physical, sensory, intellectual, and neurodevelopmental impairments can influence

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an individual's ability to engage in PA, reduce SB, and achieve adequate sleep [6]. Importantly, disability should not be understood solely in terms of an individual's impairment but also in relation to the social, environmental, and structural barriers, including discrimination, that may restrict participation and opportunities for healthy behaviors [22]. Consequently, children and young people with learning disabilities may be less likely to meet the 24-hour MB guidelines and may therefore be at greater risk of adverse physical and mental health outcomes [15,19,23].

To date, there is a notable lack of both quantitative and qualitative evidence from the United Kingdom on adherence to the 24-hour MB guidelines among children and young people with learning disabilities. Existing research has predominantly focused on specific conditions that may include some individuals with learning disabilities but are not representative of this group as a whole. Consequently, the MB patterns, experiences, and support needs of young people with learning disabilities remain poorly understood.

Despite growing evidence demonstrating the health benefits of meeting the 24-hour MB guidelines [14], little is known about adherence and associated outcomes among young people with learning disabilities. Existing research has focused predominantly on broader populations of people with disability or on people with specific conditions [15-17], limiting understanding of the unique MB patterns and support needs of young people with learning disabilities. Furthermore, evidence from the United Kingdom is particularly sparse, with no studies examining adherence to all components of the 24-hour MB guidelines in this population.

Addressing this knowledge gap is important for informing intervention development. The UK Medical Research Council (MRC) framework for developing and evaluating complex interventions highlights the importance of understanding the target population and identifying barriers and facilitators to behavior change during the early stages of intervention development [24,25]. Therefore, this mixed methods study aims to investigate adherence to the 24-hour MB guidelines among young people with learning disabilities in Scotland, United Kingdom, and to explore the individual, social, and environmental factors that influence these behaviors. The findings are expected to inform the development of future evidence-based and theory-informed interventions to support healthy MBs in this underserved population.

The aim of this study is to investigate 24-hour MBs among young people with learning disabilities, examine adherence to the 24-hour MB guidelines, explore factors influencing these behaviors, and assess the feasibility of using objective and self-report measures to study 24-hour MBs in this population.

Research Questions

The study addresses the following research questions:

- To what extent do young people with learning disabilities in the United Kingdom adhere to the 24-hour MB guidelines?
- What individual, social, environmental, and contextual factors influence adherence to the 24-hour MB guidelines?

Methods

This mixed methods study investigated adherence to the 24-hour MB guidelines among young people with learning disabilities. Quantitative and qualitative data were collected to examine MB patterns and explore the individual, social, and environmental factors that influence guideline adherence.

Design and Recruitment

The proposed sample size (N=60) was based on previous successful recruitment within additional support needs (ASN) school settings [26], available resources and timelines, and the need to capture variation across multiple schools to explore behavioral, social, and environmental influences on 24-hour MB adherence. As a feasibility study, the primary aim was not hypothesis testing but rather the estimation of MB patterns and feasibility outcomes. A target sample of 60 participants was intended to provide preliminary estimates of adherence to the 24-hour MB recommendations and inform sample size calculations for future definitive studies. As no UK or Scottish data were available on adherence to the 24-hour MB guidelines among young people with learning disabilities, the data collected were intended to provide important preliminary evidence while also evaluating the feasibility and acceptability of the proposed measurement methods. The recruitment target of 60 participants included all individuals who provided consent and enrolled in the study. Participants who did not meet the accelerometer validity criteria were included in recruitment, retention, and feasibility analyses but were excluded from the primary analyses of 24-hour MBs.

Participating schools received information about the study and assisted in identifying eligible participants. School staff advised the research team on appropriate communication methods and any support requirements needed to ensure that recruitment materials and study procedures were accessible. Information packs, including participant and parent or guardian information sheets and consent forms, were distributed through schools. A member of the research team visited each school to introduce the study, answer questions, and support the consent and assent process using accessible communication approaches. The research team also attended parent information events, where available, to provide families with further information and answer questions about participation.

Consent Procedures

Consent procedures were tailored according to participants' age and capacity to provide informed consent. Capacity was assessed individually through consultation with school staff and discussion with participants to establish their understanding of the study purpose, procedures, and right to withdraw at any stage without consequences.

Participants aged ≥16 years who were deemed to have capacity provided written informed consent. Participant information sheets and consent forms were made available in both standard and easy read formats, as appropriate. Although parental consent was not required for this group, parents or guardians were informed about the study and their young person's participation. Participants were encouraged to share study information with

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their parents or guardians, and schools supported communication with families, where appropriate. For participants aged 11 to 15 years, written parental or guardian consent and participant assent were obtained prior to participation. School staff advised the research team regarding parental responsibility arrangements, including circumstances involving local authority guardianship. All study information was provided in accessible formats suited to participants' communication needs.

Ethical Considerations

Ethics approval was granted by the University of Strathclyde Ethics Committee (UEC25/10). Informed consent or assent, as appropriate, was obtained from all participants prior to participation, as described above. Participants received a £20 (£1=US $1.33, as of October 19, 2026) gift voucher in recognition of their contribution.

All study data were managed in accordance with the University's data management and information governance procedures. Electronic data were stored on secure, password-protected University servers, while paper records were kept in locked storage within the University.

Participants were assigned a unique study identification number and pseudonym to ensure anonymity. Identifiable information was stored separately from study data and was accessible only to authorized members of the research team. Interview recordings were stored securely, transcribed verbatim, and anonymized prior to analysis. Once transcription accuracy had been confirmed, audio files were deleted.

Measures

PA, SB, and sleep were assessed using ActiGraph GT3X accelerometers (ActiGraph LLC). The ActiGraph is a widely used and validated measure of MBs in children and young people, including those with disabilities [27-29]. Following consent or assent, participants received an accelerometer either at a parent information event or during a school visit by the research team. Participants and their families received verbal and written instructions on device wear and completion of study materials.

Participants were asked to wear the monitor on an elastic belt positioned at the right hip for 7 consecutive days, including weekend days. Devices were initialized at 100 Hz using 5-second epochs. For the primary analysis, participants were required to provide at least 4 valid 24-hour days of accelerometer data, including a minimum of 3 weekdays and 1 weekend day. A valid day was defined as ≥20 hours of wear time with a valid overnight sleep period. Days that did not meet these criteria were excluded from the primary analyses but retained for feasibility reporting in future publications. Parents or guardians completed a 7-day diary documenting periods when the device was removed (eg, bathing or swimming), sleep schedules, and any deviations from usual routines. These records supported accelerometer data processing and interpretation. Parents or guardians also completed a brief questionnaire, developed from measures used in previous 24-hour MB research [30], reporting their child's recreational screen time, perceived PA levels, and typical sleep duration and timing. These self-reported data provided contextual information and enabled comparisons with accelerometer-derived estimates.

Upon completion of data collection, accelerometer and diary data were used to generate an individualized activity profile for each participant, illustrating the time spent in PA, SB, sleep, and screen-based activities over a typical 24-hour period. These personalized profiles were shared with families and served as discussion tools during the qualitative interviews. This chart has been used successfully in a previous study [30]. Adjustments to the chart were made according to each participant's age, taking into account age-specific recommendations for sleep duration. Each participant received their chart prior to the interview.

Study Procedure

Following the consent and assent procedures, participants completed study measures and wore an ActiGraph GT3X accelerometer continuously for 7 consecutive days. Parents or guardians completed the accompanying questionnaires and diaries. Following data collection, accelerometer and diary data were used to generate personalized activity profiles, which were shared with participants and their families. A purposive subsample of participants subsequently participated in semistructured interviews.

Qualitative Interviews

A purposive subsample of approximately 10 participants was invited to take part in a semistructured interview within 1 month of receiving their personalized activity profile. Participants were selected based on their ability to engage in a conversational interview and respond to simple questions. Personalized activity profiles generated from the quantitative data were used to support discussion and reflection during interviews. Interviews were conducted in a quiet room within the participant's school. Where appropriate, participants could invite a support for learning worker to be present.

The interviews explored participants' understanding of the 24-hour MB guidelines, along with the individual, social, environmental, and contextual factors that influence adherence. Particular attention was paid to identifying barriers and facilitators to engaging in healthy MBs. The interview guide was informed by established behavior change frameworks, including the capability, opportunity, and motivation–behavior (COM-B) model [31], the theoretical domains framework (TDF) [32] and the behavior change wheel [33,34] (Multimedia Appendix 1). Following inductive theme development, a deductive analysis is being conducted using the COM-B model and TDF. Themes and subthemes will be mapped to relevant COM-B components and TDF domains to identify potential behavioral determinants influencing 24-hour MBs. This additional analytic step will facilitate interpretation of findings within an established behavior change framework and support the identification of potential intervention targets for future research and practice. A COM-B or TDF mapping table will be developed to illustrate the relationship between qualitative themes and behavioral determinants. Interviews also explored the acceptability and perceived usefulness of the study measures and procedures. All interviews were audio-recorded, transcribed verbatim, and are being analyzed using thematic analysis [35].

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Data Analysis

Quantitative Analysis

Accelerometer data is being processed using ActiLife software (version 7.0; ActiGraph LLC). Time spent in SB, light PA, moderate PA, vigorous PA, and sleep will be calculated using established protocols and validated cut points for children and young people [36]. Nonwear periods will be identified using parent-completed wear diaries and corroborated through inspection of accelerometer data. Recorded device removals (eg, bathing or swimming) will be treated as nonwear time and excluded from analyses.

Descriptive statistics are being used to summarize MBs and determine the proportion of participants meeting the 24-hour MB guidelines. Descriptive statistics are being used to summarize MBs and determine the proportion of participants meeting the 24-hour MB guidelines. Sleep outcomes will be estimated using accelerometer-derived algorithms and verified against parent-reported sleep diary data to improve classification accuracy [37,38]. Parent-reported sleep diary data and movement data will be used to identify rest intervals following approaches outlined by Patel et al [39] and modified accounting for the population (young people, placement of device [hip] and information available [no marker]).

Qualitative Analysis

Interviews were transcribed verbatim and are being analyzed using thematic analysis [35] in NVivo 2020 (QSR International). An initial inductive analysis will be used to explore participants' experiences, perceptions, and understanding of 24-hour MBs. Following inductive coding, a deductive analysis informed by the COM-B, the TDF, and the behavior change wheel will be undertaken to map barriers and facilitators to guideline adherence theoretically. The analysis will be conducted by the primary researcher following a 6-phase approach developed by Braun and Clarke [40] for thematic analysis. A purposive sample of transcripts will be independently coded by a second researcher to enhance trustworthiness and analytic rigor. Emerging codes, themes, and interpretations will be reviewed and discussed during regular analytic meetings, with differences resolved through consensus. Data analysis will be iterative, with themes continuously refined to ensure coherence and rich representation of participants' experiences. Reflexive memos and an audit trail will be maintained throughout the study to document analytic decisions and promote transparency.

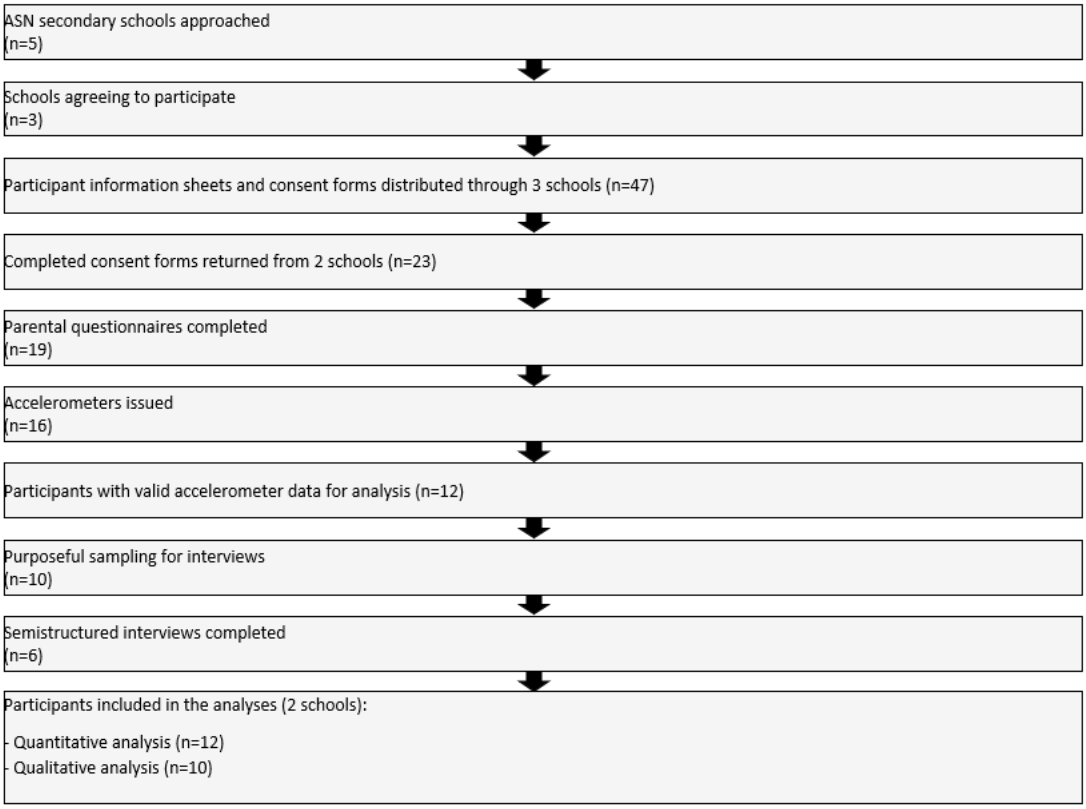
Integration of findings from both data strands is intended to provide a comprehensive understanding of MBs among young people with learning disabilities and inform the future development of theory-informed interventions to support adherence to the 24-hour MB guidelines.

Results

The study was funded from April 2025 to July 2026. Recruitment and data collection were completed in June 2026. This manuscript describes the study protocol and planned analytic approach; data cleaning and analysis were ongoing at the time of manuscript submission. Quantitative and qualitative findings will be reported in future peer-reviewed publications. Means, SDs, and proportions of participants meeting each guideline will be calculated. Adherence to individual and combined 24-hour MB recommendations will be reported descriptively. Figure 1 presents the recruitment pathway and the number of participants included at each stage of the project.

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Figure 1. Participant recruitment pathway. ASN: additional support needs.



Discussion

Anticipated Findings

This study addresses an important evidence gap by examining adherence to the 24-hour MB guidelines among young people with learning disabilities in the United Kingdom. To our knowledge, this is the first mixed methods study in the United Kingdom to examine all components of the 24-hour MB framework among young people with learning disabilities. Given the growing recognition that PA, SB, and sleep are interdependent, understanding these behaviors within a 24-hour framework is essential for informing intervention development [4,41,42].

A key strength of the study is its mixed methods design, which combines objective measures of MBs with qualitative exploration of young people's experiences and perceptions of MBs. The use of personalized activity profiles is expected to support participant engagement and facilitate reflection on daily MBs. By incorporating the perspectives of young people with learning disabilities, the study is expected to provide valuable insights into the behavioral, social, and environmental factors influencing adherence to the guidelines.

Several methodological challenges should be acknowledged. Sleep assessment remains complex because sleep disturbances and irregular sleep-wake patterns are common among young people with learning disabilities [5,21]. To improve measurement accuracy, accelerometer-derived estimates will be combined with parent-completed sleep diaries collected over 7 consecutive days, including weekends [37,38,43]. Similarly, the assessment of SB and PA can be challenging for participants who use manual wheelchairs. Parent-completed diaries will therefore be used to identify periods of monitor nonwear, and data from wheelchair users will be considered separately, where appropriate. The Evenson accelerometry cut points for measuring movement intensity were selected because of their strong performance in children and young people [36,44]. Accelerometer data will be checked manually along with the self-reported sleep diary data.

Interpretation of the findings may also be limited by inconsistencies in the existing literature regarding terminology, population definitions, and measurement protocols. Many previous studies have focused on only 1 MB or have examined broader populations of people with disabilities, making comparisons difficult. By simultaneously assessing PA, SB, and sleep in a clearly defined population, this study aims to provide a more comprehensive understanding of 24-hour MBs among young people with learning disabilities and contribute to the development of future interventions.

Strengths and Limitations

The principal strength of this study is its mixed methods design, combining objective accelerometer data with qualitative exploration of participants' experiences and perceptions of MBs. The integration of multiple data sources, including diaries, questionnaires, and interviews, is expected to provide a comprehensive understanding of MBs and the factors influencing adherence to the 24-hour MB guidelines. Furthermore, the inclusion of young people with learning disabilities as direct informants represents a significant strength,

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as this population has been underrepresented in MB research. The use of accessible recruitment, consent, and interview procedures further supports the meaningful inclusion of young people with learning disabilities in the research process.

Several limitations should also be considered. As a feasibility study, recruitment was restricted to ASN secondary schools within 2 Scottish regions, which may affect the generalizability of the findings. In addition, challenges remain in accurately measuring sleep and SB, particularly among participants with complex support needs or those who use wheelchairs. Finally, variation in terminology and methodology across the existing literature may limit direct comparisons with previous studies.

Conclusions

This study is expected to provide the first UK evidence on adherence to the 24-hour MB guidelines among young people with learning disabilities. By integrating objective measurement with qualitative exploration of lived experiences, the study is expected to improve understanding of MB patterns and their determinants within this underserved population. The findings are expected to inform the development of tailored, theory-informed interventions and provide an important foundation for future research aimed at promoting health, well-being, and equitable opportunities for participation in healthy MBs among young people with learning disabilities.

Acknowledgments

The authors thank the Baily Thomas Charitable Fund for their collaboration and for the opportunity to represent this underserved population.

Funding

This study was funded by the Baily Thomas Charitable Fund (grant ID PWFO/RA/SG/6897/10243).

Generative AI Use

The authors declare that generative AI was not used in the preparation of this manuscript.

Authors' Contributions

FM conceptualized the study, acquired funding, and made substantial contributions to the design, preparation, and revision of this manuscript. FM is responsible for the overall management, coordination, leadership, and oversight of the research. AD made substantial contributions to drafting the first version of this paper. AD was responsible for conducting the research and investigation, specifically coordinating the collection and analysis of quantitative and qualitative data. In addition, JJR, MC, CD, and FB advised on the design and implementation of this study. All authors read and approved the final manuscript.

Conflicts of Interest

MC is a consultant for Signifier Medical Technologies. All other authors declare no other conflicts of interest.

Multimedia Appendix 1

Qualitative interview guide.
[DOCX File , 16 KB-Multimedia Appendix 1]

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Abbreviations

ADHD: attention-deficit/hyperactivity disorder
ASD: autism spectrum disorder
ASN: additional support needs
COM-B: capability, opportunity, and motivation–behavior
MB: movement behavior
MRC: Medical Research Council
PA: physical activity
SB: sedentary behavior

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TDF: theoretical domains framework
WHO: World Health Organization

Edited by J Sarvestan; submitted 03.Mar.2026; peer-reviewed by B Belcher; comments to author 19.Aug.2026; revised version received 17.Sep.2026; accepted 12.Oct.2026; published 12.Nov.2026

Please cite as:
Dalziell A, Reilly JJ, Crawford M, Donnachie C, Bardid F, Muirhead F
Investigating 24-Hour Movement Behaviors in Young People With Learning Disabilities: Protocol for a Mixed Methods Study
JMIR Res Protoc 2026;15:e94581
URL: https://www.researchprotocols.org/2026/1/e94581
doi: 10.2196/94581
PMID:

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